Effectiveness of GeoGebra as Instructional Media on Mathematics’ Learning Outcome of Students in Eighth Grade SMP Negeri 6 Palopo

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Abstract

This study is a quasi-experiment employing the research design of one group pre-test post-test. The objectives were: (1) to measure the learning outcomes of students in grade VIII of SMP Negeri 6 Palopo before and after the implementation of GeoGebra as an instructional media; and (2) to examine the increase of students’ learning outcome in class VIII SMP Negeri 6 Palopo after the use of GeoGebra in assisting the learning. Data collection technique composed of two tests which were pre-test (before the treatment was given) and post-test (after all session of the learning assisted by GeoGebra was done). The sample was selected through cluster random sampling leading to the researcher to choose a class. As for the data analysis techniques, they were descriptive and inferential analysis. Results indicated that there was an improvement in the mathematics’ learning outcome of students in the eighth grade of SMP Negeri 6 Palopo after they were taught by employing GeoGebra as an instructional media.

Keywords: instructional media, GeoGebra, mathematics’ learning outcome

1. Background

Education is an endless process because it is essential for every human being. Education is a conscious and planned effort to realize learning environment and learning process that enables students to actively develop their potential to possess spiritual-religious power, self-control, personality, intelligence, noble character, as well as skills need by themselves, community, and the nation and state (Law of The Republic of Indonesia on National Education System, 2003). According to Law of The Republic of Indonesia Number 2 of 1985, the educational goals are to educate national life and develop every person as a whole which is faithful and pious toward the one almighty God, has virtuous character, and possess knowledge, skills, physical and spiritual health, great and independent personality as well as sense of responsibility in nation and state. Based on the previous explanation, it can be inferred that all citizen of Indonesia has the right to get an education according to the ideals of the nation contained in The 1945 Constitution of the Republic of Indonesia.

Nowadays, school mathematics becomes one of the subjects that students are not interested in. It is due to this condition that the role of a teacher is needed to minimize the their lack of interest. Ma’rufi, Budaya, and Juniati (2018) said that mathematics teacher does not only have to master the mathematics’ concept that is taught but also master the way to teach the material, and know the students’ thinking so that students can easily understand

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the concept. According to the Law of The Republic of Indonesia Number 14 of 2015 in Article 1 Section 1, teachers are expected to motivate students in various ways as well as create a more active learning environment by presenting creations with the main objectives being to enable students to think critically and logically.

In its development, mathematics learning in Indonesia could be categorized as unsatisfactory. In the national examination in the year of 2011/2012, the average score of the mathematics exam had a great range between the highest and the lowest score. This is a hint that indicates the presence of shortcoming as well as learning difficulty from the students with the low score. It showed that many students have a lack of mastery in mathematics. One of the five purposes of mathematics learning according to Standard of Content in Regulation of The Minister of National Education of The Republic of Indonesia Number 22 of 2006 is to communicate ideas by symbols, tables, diagrams, or other media to clarify situations and problems. However, a study by Rohaeti (2003) discovered that the average of students’ communication skill in Indonesia is in a low category. Similarly, Purniati (2003) said that students’ responses toward mathematical communication problems are generally low. In line with Purniati, The Third International Mathematics and Science Study [TIMSS] (2007) discovered that Indonesia is in 36th position out of 48 participated countries in the mathematical communication aspect.

National examination uncloak that the low absorption capacity of students in particular topics of mathematics where one of the topics is solid geometry. Nur’aiini, et al (2017) said that Geometry is one of the fields in mathematics studying about points, line, plane, and solid figures as well as their properties, measures, and relationship among the concept. Compared to other fields in mathematics, geometry is said to be one of the most complicated topics to be understood. It is also the topic which student’s absorption capacity is very low. There are numerous applications of the topic in real-life situations such as determining the geometrical shape of a computer network topology, the slope when putting the ladder on the wall, the angle formed in a clock, and the translation of particular solid or plane figures.

As one of the subjects in school, mathematics plays a vital role in the development of science and technology. As science advances in this modern era, teachers are expected to utilize technology as one of the media to transfer knowledge. Through various kinds of technology, education can help students with different learning skills and provide more opportunities in education (Molnar, 2014). Technology, particularly the computer, become a media that bridge the abstract idea of mathematics with the concrete one. Sunarto (Nopiyani, et al., 2016) said that study time will be far more effective if learning strategy using computers is utilized.

According to Dewi, et al (Sari, 2016) GeoGebra is a software of dynamic geometry system that constructs points, vectors, line segment, lines, conic section, and even function and transform it dynamically. Instructional media such as GeoGebra help the process of mathematics teaching and learning and also make the teaching and learning activities to be more enjoyable and less monotonous. Purwanti, et al (2016) say that GeoGebra is a dynamic software that incorporates geometry, algebra, and calculus. Based on the previous definitions, it can be concluded that GeoGebra is one of the geometry software that constructs points, vectors, and others dynamically as well as can help in solving algebra and calculus. Based on the background of the problem, researcher finds it a must to research a study concerned mathematics learning by employing GeoGebra as an instructional media on the topic of polyhedrons to enhance the understanding of students in eighth grade of SMPN 6 Palopo.

2. Methods
This study is a quasi-experiment that involved one class. Before the treatment (learning by utilizing GeoGebra), a pre-test was given and then followed by post-test after the lesson finished.

The sample of the research were 28 students from class VIII E SMP 6 Palopo in the academic year of 2018/2019. As for the focus of the study, it was the learning by employing GeoGebra to assist the learning in the topic of polyhedrons. The study began by administering the pre-test to the class before the treatment and followed by six sessions of learning and then ended by post-test after the treatment.

Limitations regarding the concerned variables were given operationally which are: (1) GeoGebra used to aid the instruction in the study were GeoGebra ver. 6.0.518.0; (2) students’ activity is activity or behavior that students exposed during the learning process; (3) students’ response is response toward learning methods, group work results, students’ textbooks, and the way the teacher teaches; and (4) the higher-order thinking skill question used in the research is higher-order thinking skill by using questions in the form of essay.

The research instrument consists of validation sheet, observation sheet, students’ response questionnaire, and test of learning outcomes. Observation sheet of students’ activity was intended for examining and monitoring to what extent the activities carried out by students during the learning process takes place. As for the students’ response questionnaire, it was subjected to students after the learning process ended to collect data regarding students’ response learning activities that employ GeoGebra. Test of students’ higher-order thinking skill was given before and after the treatment to find out their skill before and after the learning was implemented. The tests comprised six questions in the form of an essay where the questions used in the pre-test and post-test were different.

3. Results and Discussion

Students’ Activity

Analysis result of students’ activity score revealed that the mean score for every aspect during all session was 3.49. Overall, the activity was in the category of active (2.5≤x̅<3.5) according to the criteria of activity effectiveness. Students’ activity to participate in learning was shown by asking for unclear things, taking notes, listening, thinking, and every activity meant for supporting the learning process.

Students’ Response

Results of the analysis showed that the mean score of students’ response toward GeoGebra aided instruction was 3.15. The score was in the category of quite positive in terms of students’ response category.

Students’ Mathematics Learning Outcome

Mathematics’ learning outcome of students taught before and after the utilization of GeoGebra to assist learning is presented in the following table.

Table 1. Descriptive statistics of students’ mathematics learning outcome prior to and after taught by using GeoGebra as an Instructional Media

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Scores</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>28</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>48</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>13</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>35</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>28,75</td>
<td>80,61</td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>12,52</td>
<td>4,29</td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>156,71</td>
<td>18,39</td>
<td></td>
</tr>
</tbody>
</table>
Based on Table 1, there was a significant difference in students’ learning before they were taught by utilizing GeoGebra and after they were taught by employing the software. Before the treatment, the highest score was 48 while the lowest one 13 with a mean score of 28.75 and standard deviation of 12.52. These scores indicated that mathematics learning outcome was still centered on 28.75. The standard deviation value revealed that the measure of deviation from the mean was 12.52. However, after the students were taught by using GeoGebra in assisting the learning, the maximum score was 90 while the lowest one was 75 with the mean score of 80.61 and standard deviation of 4.29. The mean score indicated that mathematics’ learning outcome was centered on 80.61 and the standard deviation score tells us that the measure of deviation from the mean was 4.29. Descriptively, it could be said that the mathematics’ learning outcomes of students in class VIII E after they were given the treatment was higher than before it.

**Discussion**

GeoGebra usage to assist learning encouraged students to actively involved in learning. Students’ activity to participate in the lesson were shown by questioning unclear things, taking notes, listening, thinking, and every activity that was done to aid the process of learning. According to Dimyati and Mudjiono (Ware, 2014), students’ activity in learning contains various forms, ranging from the easily observed physical one to one that involves mental activity which is hard to observe. The examples for the former one are in the form of reading, listening, demonstrating, and measuring while the latter consists of activity such as recalling the previous lesson, concluding experiment results, comparing concepts each other, and others.

Based on the analysis result of observation data of students’ activity, it could be seen that there was an improvement in the percentage of students’ activity for every indicator in every session. As for the mean score of all students’ activity during the use of GeoGebra from the first session until the sixth one was 3.49. This was categorized as active based on the effectiveness criteria.

Generally, responses toward the employment of GeoGebra tended to be positive. Numerous students reacted positively toward the learning components implemented by the teacher in the classroom such as students’ worksheet and learning environment. Most of the students choosing good or very good showed that there was a positive response toward the component of the learning with GeoGebra. Based on the result of students’ response toward the utilization of GeoGebra as instructional media, the mean score of the questionnaire was 3.15 which was in the good category. Thus, it satisfied the criteria of effectiveness.

The mean test score of mathematics’ learning outcome measured through pre-test (before the first session of learning) and post-test (after the use of GeoGebra) in the experiment class experienced an increase. This was due to the employment of GeoGebra that enabled students to study while socializing with their peers which leads to students being less reluctant to ask their group mates for unclear things. The use of visual media was also arranged and designed to enable students to analyze topics like polyhedrons and create a short description of what was in the given image.

The result of descriptive statistical analysis revealed that the mathematics’ learning outcome of students in class VIII E SMP Negeri 6 Palopo after taught by the implementation of GeoGebra was high in overall.

Such result was achieved because the learning that utilize GeoGebra did not only involve dynamic interaction between teacher and students but also between students, which could attract students’ interest to learn and motivated students to actively learn, whether in or out of the classroom as well as can made the learning process become more fun. Sudirman, Coesamin, & Gunowibowo (2013) said that the utilization of technological software helps
students to memorize and apply learning material whether in answering questions or in real-life situations.

4. Conclusion

1. Mathematics’ learning outcome of students in class VIII E SMP Negeri 6 Palopo taught before employing GeoGebra as an instructional media in the topic of polyhedrons has an average of 28.75 out of 100 with a standard deviation of 12.51.

2. Mathematics’ learning outcome of students in class VIII E SMP Negeri 6 Palopo taught after using GeoGebra in the topic of polyhedrons has an average of 80.61 out of 100 with a standard deviation of 4.29.

3. Students’ activity during the learning with GeoGebra in the topic of polyhedron is in the positive category with the score of 3.49.

4. Students’ response after using GeoGebra during learning is in the positive category with the score of 3.15.

5. There is an increase in students’ learning outcome after taught by employing GeoGebra as an instructional media in the topic of polyhedrons with an average of 80.61.

6. The result of statistical inferential analysis by using t-test concludes that the use of GeoGebra in assisting learning in the topic of polyhedrons is said to be effective because of the satisfied learning effectiveness’ criteria.

5. Citation and References


